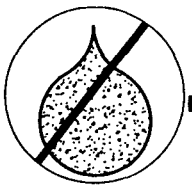


NONPOINT SOURCE POLLUTION

Point source pollution has a well defined point of entry into the waterway such as a pipe from an industry. Nonpoint source pollution does not enter the waterway from a single point or originate from a single location. It occurs from many widespread activities within the watershed including agriculture, timber harvesting, construction, development of urban areas, mining, failing septic systems, urban runoff, etc. Thus, any chemical or waste product on the ground can become nonpoint source pollution. Some specific pollutants include:

- acid rain
- acid mine drainage
- fertilizers
- pesticides
- animal waste runoff
- automotive fluids such as oil and antifreeze
- road salts
- soil erosion
- raw sewage

Nonpoint source pollution occurs when surface runoff picks up these pollutants as it flows over the ground and transports them to nearby bodies of water. When the runoff reaches less saturated areas it soaks into soil to the groundwater carrying the pollution with it (Mississippi Department of Environmental Quality, 1993).

In Kentucky, the greatest and most widespread source of water pollution comes from contaminated runoff from farms, coal mines, and urban areas as well as:

- poorly operated sewage treatment plants
- malfunctioning septic systems
- soil erosion
- illegal straight pipes (Kentucky Environmental Quality Commission, 1994)

Nonpoint source pollution affects Kentuckians by increasing the cost of treating drinking water and wastewater, the loss of recreational activities such as swimming and fishing, the incidence of flooding, and the risk of exposure to contaminants and pathogens (Wisconsin Department of Natural Resources, 1989).

The amount of nonpoint source pollution could be reduced by:

- limiting surface runoff
- keeping surface runoff clean
- maintaining or restoring native vegetation in buffer zones next to ponds, sinkholes, streams, etc.

Also, Kentucky farmers are now required to have a water quality protection plan for their land to reduce the incidence of nonpoint source pollution from agricultural areas.

The activities in the following sections illustrate nonpoint source pollution.

NONPOINT SOURCE POLLUTION WALKING TOUR

GRADES: K-A
SUBJECT: Geography, Science, Social Studies
SKILLS: Analyzing, applying, classifying, describing, discussing, identifying, listing, mapping, observing, recognizing, visualizing.
DURATION: 1 to 2 hours
SETTING: Outdoors
KERA ACADEMIC EXPECTATIONS: 1.3, 1.10, 2.19, 3.6, 5.3, 6.1, 6.2

OBJECTIVE: To define and identify local problems of nonpoint source pollution.

METHOD: Take a walking tour of neighborhood looking for examples of nonpoint source pollution.

MATERIALS NEEDED:

- Paper
- Pencils
- Clipboards
- Topographic or road maps

PROCEDURE:

- Take a walking tour of neighborhood looking for nonpoint source pollution.
- List pollution seen and plot locations on map.
  ex.: automotive fluid spills on roadways, gas stations, parking lots, etc.
  decayed organic material
  trash in gutters, storm drains, or roadside ditches
  evidence of lawn treatment: flags, fertilizer pellets on sidewalks or in gutters
  soil erosion
  road salt
  trash in sinkholes
  crop fields or livestock next to waterways
- Determine from maps what watershed would be affected by this pollution.

EVALUATION: This activity demonstrates that nonpoint source pollution can be found everywhere.

- What is the land use in the area of the walking tour? (farms, urban, residential, etc.)
- What types of pollution were found?
- Where was the most amount of pollution found? Why?
- Where was the least amount of pollution found? Why?
- What watersheds are affected by this pollution?
- What could be done to minimize these effects?

EXTENSIONS:

- Write a report on what was found and present it to concerned citizens.
- Write a newspaper article or letter to the editor.
- Join an existing environmental group or start one in order to clean up some of the pollution.

(activity designed by Cathy L. Neeley)

OTHER RESOURCES

GRADES:

K-A Firehock, Karen, 1994, Classroom Activity #1 - Can You See Water Pollution?: Hands-on Save Our Streams, Teacher's Manual, chpt. 2, pp. 50-53.
How to tell if water is polluted.
_____, Classroom Activity #2 - Making the Land and Water Connection: Hands-on Save Our Streams, Teacher's Manual, chpt. 3, pp. 81-127.
Study land use and potential sources of pollution.

4-8 The Watercourse and Council for Environmental Education, 1995, Macroinvertebrate Mayhem: Project WET, pp. 322-327.
Game to simulate effects of environmental stressors on macroinvertebrate populations.
The Watercourse and Council for Environmental Education, 1995, Sum of the Parts: Project WET, pp. 267-270.
How everyone contributes to nonpoint source pollution in the watershed.

6-8 Vandas, Stephen, Dispersion of Nonpoint Source Pollution: Water Resources Initiative, U.S. Geological Survey, Poster Series, Water Quality Potential Sources of Pollution.
Become aware of the difficulty of determining the source of pollution.
Vandas, Stephen, How Substances are Measured in Water: Water Resources Initiative, U.S. Geological Survey, Poster Series, Water Quality Potential Sources of Pollution.
Visualize extremely small concentrations of a material.

ACIDIC WATER

Most freshwater fish and bottom dwelling aquatic organisms prefer water with little or no acid in it. When the pH (acidity/alkalinity measurement) of a stream goes below 6.0 or above 9.0 (the neutral range) few organisms survive (Kentucky Water Watch Program, 1993). Water with a pH below 5.0 is acidic which causes:

- more metals such as lead and cadmium to be released into the water
- more mercury to be accumulated in the food chain
- the slowing of photosynthesis
- fish fry (hatchlings) to die off (Ahl, Robert S., 1996)

Low pH levels in a stream can be caused by acid rain and acid mine drainage.

Rain is naturally acid with a pH between 5.0 and 6.0. Acid rain is any type of precipitation with a pH below 5.0. It occurs when water vapor condenses around air pollution particles such as airborne dust, sulfur dioxide, and nitrogen oxides forming sulfuric and nitric acids that fall to the earth as acid rain. The main sources of acid rain are:

- coal burning
- ore smelting
- internal combustion engines (cars, trucks, etc.) (Ahl, Robert S., 1996)

Acid rain could be reduced by:

- using sources of energy other than coal
- installing scrubbers on factory exhausts and smoke stacks
- installing pollution controls on cars (Ahl, Robert S., 1996; Barnhisel and Hower, 1996)

Kentucky gets its share of acid rain, but in areas where limestone and other carbonate rocks are present, the calcium dissolved out of the rocks by the acid raises the runoff to a higher pH.

Acid mine drainage is frequently caused by the oxidation or weathering of pyrite, a mineral that is often associated with coal seams. The oxidation of pyrite releases sulfuric acid into the environment and into nearby streams (Barnhisel and Hower, 1996). Generally, this drainage comes from abandoned deep mines, unreclaimed strip mines, and old refuse piles.

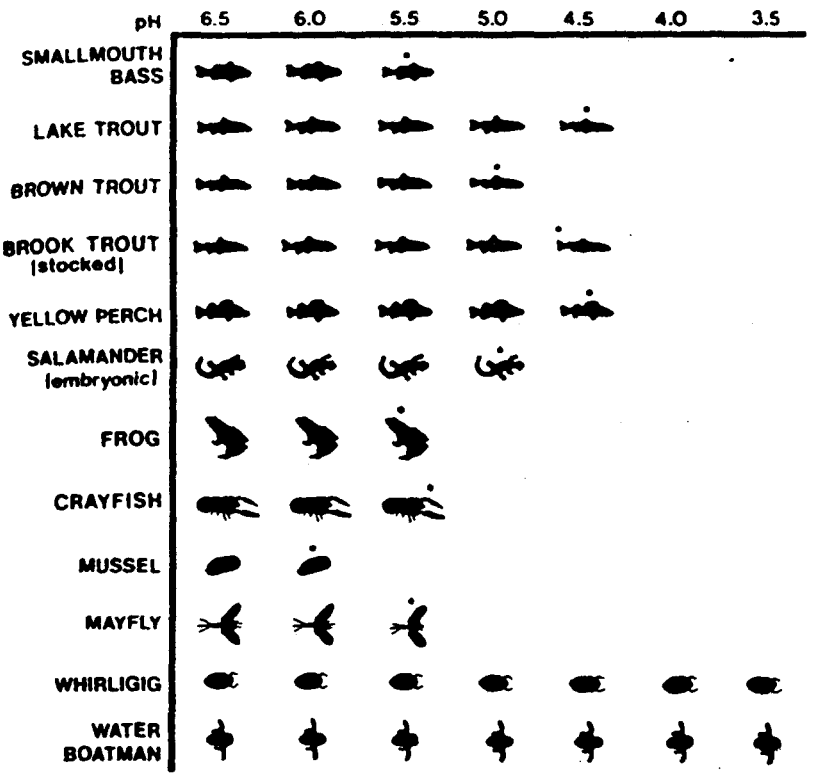
Coal mining activities, such as land disturbance and acid mine drainage, affect 63 streams in 12 counties in Kentucky. The most affected streams are tributaries of the:

- Kentucky River in Knott, Leslie, and Perry counties
- Green River in McLean, Muhlenburg, and Ohio counties - Rough and Mud rivers, Cypress, Flatt, Caney, and Drakes creeks
- Tradewater River in Christian and Hopkins counties - Coney, Buffalo, Hurricane Bull, Clear, Owens, and Crab Orchard creeks (Olem, Watson, and Ruane, 1980)

Preventing or reducing this drainage at the source is the most effective and economical approach to minimize pollution. Other methods include:

- neutralizing acid producing mine waste with lime
- treating acid mine drainage through constructed wetlands before it gets to waterways

pH AND AQUATIC LIFE



(from Kellog and Clausen)

The following activities illustrate the effect of acid on water quality.

POLLUTION MONITORING

GRADES: K-A
SUBJECT: Geography, Science
SKILLS: Analyzing, comparing, experimenting, evaluating, observing, small group work
DURATION: 15 minutes to set up, several weeks to see results
SETTING: Indoors and outdoors
KERA ACADEMIC EXPECTATIONS: 1.3, 2.1, 2.2, 4.2, 5.1, 5.3, 6.1, 6.2, 6.3

OBJECTIVE: To observe the amount of pollution in the air that may cause acid rain.

METHOD: Collect samples of air pollution.

MATERIALS NEEDED:

- Several 4x6 index cards (optional microscope slides)
- Petroleum jelly
- Marker
- Tape

PROCEDURE:

- Divide class into groups and give each group materials needed.
- Write in upper left-hand corner of card:
  POLLUTION EXPERIMENT - PLEASE DO NOT TOUCH!
  TEACHER - GROUP NAME
  DATE: _____
- Mark a large rectangle in remaining area of card and smear it with petroleum jelly.
- OR attach slide to card and smear slide with petroleum jelly.
- Mount the cards in various locations; i.e., the classroom wall, near the parking lot, etc. Do not place cards where they will get rained on.
- Check the cards after a day, a week, a month. Examine the petroleum jelly film for pollution particles. Use a microscope for the slides.

EVALUATION: This activity demonstrates the amount of pollution in the air that might be causing acid rain in the community.

- Compare the cards from the various locations.
- Can any pollution (dust particles) be seen?
- Why do some cards have more pollution than others?
- Where could the pollution have come from?

EXTENSIONS:
Graph the results, compare seasonal changes.

(adapted from National Wildlife Federation)

THE GENTLE RAIN

GRADES: 4-A*
SUBJECT: Science
SKILLS: Data collecting, discussing, measuring, observing, recording
DURATION: Collection times will vary, classroom testing - 30 min.
SETTING: Indoor and outdoor components
KERA ACADEMIC EXPECTATIONS: 1.3, 1.8, 1.10, 2.1, 2.2, 2.3, 2.10, 2.19, 3.7, 5.1, 5.3, 6.2, 6.3

OBJECTIVE: To determine if the community is affected by acid rain.

METHOD: Measure pH of rainfall at various sites in community.

MATERIALS NEEDED:

- pH test kit or litmus paper
- Clean wide mouth plastic jars and lids, one for each participant
- Distilled water
- Map of community
- Worksheet - The Gentle Rain, one for each participant

PROCEDURE:

- Rinse jars with distilled water, dry, and leave capped until ready to collect rainwater.
- Watch weather for good rainfall prediction, have students take home a jar when rain is imminent.
- At home students should uncap jar (do not touch inside), set jar outside to catch rainfall and fill out worksheet.
- Bring the jars back to class and test pH using litmus paper or test kit.
- Record locations of jars, wind direction, and pH for all samples.

EVALUATION: This activity detects the presence of acid rain in the community.

- What was the average pH for the community?
- Did wind direction have a bearing on pH?
- What were the possible sources of air pollution that would cause acid rain in the community?
- What can be done to reduce the air pollution?

EXTENSIONS:
At school, collect rain samples from the start and near the end of a shower.

- Was there a difference in pH? Why?

Compare rainfall pH with other water sources such as stream, pond, or tap water

- Was there a difference in pH? Why?

* For Grades K-3 test various substances for acidity including rainwater, stream water, and tap water.

(Adapted from National Wildlife Federation, 1982)

WORKSHEET - THE GENTLE RAIN

Use this worksheet to record data at the rain collection site. Information requested in questions 7 and 8 can come from the weather bureau, local newspapers, or TV weather reports, but should reflect the conditions during the rainstorm.

1. Recorder's name _____

2. Location of test site _____

3. Date _____ Time _____

4. Site description (vegetation, physical appearance, buildings, etc.)

   _____

   _____

5. Rainfall log:
   Time rain began _____ Time stopped _____

   Time collection began _____ Time stopped _____

   Total period of rainfall _____

6. Intensity of rainfall (downpour, medium, light, mist) _____

7. Wind direction _____

8. Wind speed _____

9. pH of sample _____

(Adapted from National Wildlife Federation, 1982)

OTHER RESOURCES

GRADES:

1-A Western Regional Environmental Council, 1987, Deadly Skies: AQUATIC Project WILD, pp. 133-136.
Simulation and direct measurement of acidity in aquatic habitats and its affect on aquatic life.

4-8 U.S. Environmental Protection Agency, 1994, Acid Rain - A Student's First Sourcebook: Office of Research and Development, Office of Environmental Processes and Effects Research, EPA/600/9-90/027a, 59p.
The effects of acid rain on forests, water, man-made materials, and people.

6-8 The Watercourse and Council for Environmental Education, 1995, Where Are the Frogs?: Project WET, pp. 279-286.
How acidic water can endanger aquatic life.

7-A Western Kentucky University, TVA, and Kentucky Natural Resources and Environmental Protection Cabinet, 1992, Death of a Lake: Waste - A Hidden Resource in Kentucky, p. 28-33.
Determine the relationship between pH and aquatic life by simulating the testing of lake water.